Living Labs – a structured approach for implementing Open and User Innovation

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1. Introduction

Ever since the industrial revolution started near the end of the 18th century, and especially with the advent of the so-called Fordism at the beginning of the 20th century, the dominant production and innovation logic aimed at vertical integration within the boundaries of a firm or company (Chandler, 1962). Only near the end of the 20th century, in terms of innovation, this dominant view was challenged in favor of a more distributed view. This shift in the dominant mode of innovation, from vertically integrated innovation towards a more distributed mode of innovation, has forced companies to alter both their research and development processes and their approach to innovation management. Instead of focusing on hiring people with all relevant skills and knowledge, and investing heavily in internal research and development capacities, companies had to actively look outside for knowledge and technology to complement internal assets. This shift in the dominant mode of innovation not only required organizations to adapt by developing or acquiring different skills and abilities, it also encouraged a growing body of research into the nature and occurrence of distributed innovation processes (Lakhani & Panetta, 2007). A lot of research has been devoted to the study of these distributed innovation processes, such as the literature on innovation networks (Klerkx & Leeuwis, 2009), innovation clusters and systems (Smits & Kuhlmann, 2004), systemic innovation (Wieczorek & Hekkert, 2012), or the resource-based view of the firm (Wernerfelt, 1984). However, following Bogers and West (2012), we focus on two major research streams that study the phenomenon of distributed innovation each from a different perspective. The **Open Innovation** paradigm takes the firm's perspective and examines the financial benefits of engaging in distributed innovation (Chesbrough, 2003; West & Bogers, 2013). In contrast, the **User Innovation** stream looks at distributed innovation processes from the perspective of the user (von Hippel, 1976; 2009). The focus of the analysis lies mainly on the circumstances in which users innovate themselves or can have a valuable contribution in innovation. Although these perspectives seem perfectly compatible with each other, the occasions where they explicitly come together remain sparse, with the case of user entrepreneurs, where users innovate and decide to commercialize their innovation themselves (Shah & Tripsas, 2007), as a rare example.

Clearly, in academic theory the shift towards distributed innovation has already taken place, but in practice, a lot of companies and innovation practitioners are still struggling with the

concrete implementation of strategies to cope with these distributed innovation processes (Chiaroni et al., 2011). Within this paper, we will look at a specific approach, promoted and supported by the European Commission, that tries to facilitate and manage distributed innovation processes through a Public-Private-People partnership with a central role for the end-user: Living Labs. Following Almirall and Wareham (2011) and Leminen et al. (2014), we define **Living Labs** as an organized approach (as opposed to an ad hoc approach) to innovation consisting of **real-life experimentation** and **active user involvement** by means of **different methods** involving multiple stakeholders, as is implied in the **Public-Private-People** character of Living Labs. Regarding these Living Labs, we take the European Network of Living Labs (ENoLL) as starting point with a self reported 345 affiliated member Living Labs[1]. However, a recent investigation into the Living Labs practice revealed a declining number of new Living Labs joining the European Network of Living Labs and an inactivity level of nearly 40% of the current Living Lab members (Schuurman, 2015). Moreover, despite the fact that Living Labs have been around for nearly a decade, in terms of conceptualization, the current literature stream is still inconsistent and sometimes contradictory. Studies have indicated that Living Labs as a concept have been used to identify a (too) wide variety of approaches and projects (Shamsi, 2008), are used interchangeably to refer to different aspects of Living Labs (Følstad, 2008; Dutilleul et al., 2010), and are not backed up by a consistent research stream or supporting theories (Eriksson et al., 2005; Schaffers & Kulkki, 2007; Ståhlbröst & Bergvall-Kåreborn, 2008; Westerlund & Leminen, 2014). Følstad (2008a) identified nine living lab characteristics, of which five were diverging, which indicates a large variety of approaches being labeled as living lab. Moreover, a second literature review two years later by Dutilleul et al. (2010) revealed five different meanings given to discern living labs in the papers they studied: 1. an **innovation system** consisting of organized and structured multi-disciplinary networks fostering interaction and collaboration; 2. real-life or **'in vivo' monitoring** of a social setting generally involving experimentation of a technology; 3. an **approach for involving users** in the product development process; 4. **organizations facilitating the network**, maintaining and developing its technological infrastructure and offering relevant services; 5. **the European movement** itself. Most recently, Westerlund and Leminen (2014) even found eight different perspectives on Living Labs.

However, to this date, a structural and systematic analysis of the Living Labs literature is missing. Therefore, within this paper we wish to fill this gap by using a clear methodology for selecting and analyzing the current body of Living Labs papers and articles. This allows to identify the main perspectives and viewpoints on Living Labs and how they have been embedded within the more established innovation theories. Moreover, this will reveal some inconsistencies in terms of levels of analysis. Based on these observations, we want to propose

[1] http://www.openlivinglabs.eu/

a new model that allows to study and conceptualize Living Labs, and embeds them within the Open and User Innovation paradigms.

2. Methodology

In order to get an overview of the State-of-the-Art of academic and empirical research into Living Labs, we conducted an exploratory review of the available literature. Hereto we constructed a sample of the most cited Living Labs papers. We used the Google Scholar academic search engine[2] and looked for articles by using the search string "Living Lab" (end of October 2014). This yielded more than 6.500 results. Subsequently, we narrowed the number of articles down by only including articles where "Living Lab" was mentioned in the title in order to weed out the articles where "Living Lab" appeared 'accidentally' (cf. the previous chapter) or only occurred on a side note. This resulted in 563 articles. From this sample, we chose to include only journal or conference papers (excluding books, book chapters, blogposts, thesisses or other citations) with a direct link to the abstract and only articles with a citation count of more than 10. This led to a total sample of 45 articles (see attachment for the full list). In order to get an overview of the number of Living Labs papers in top ranked journal, we did a similar exercise in the Web of Science database, looking for all articles that had "Living Lab" in the title. This led to 50 articles in total. In the following table we give an overview of the total number of articles from our three searches, organized per year. In terms of time intervals, we used 2006 as a turning point, as this year marked the establishment of the European Network of Living Labs and more formal support for Living Labs from the European Commission. The papers published before 2006 were merged into one category, while we give an overview of the the rest of the sample per year.

Table 1: Sample overview per year (October, 2014)

Publication year	Articles in sample (Google Scholar + 10 citations)	Articles in total (Google scholar)	WoS articles
Until 2005	4	18	3
2006	3	9	0
2007	5	15	3
2008	7	52	3
2009	6	69	8

[2] http://scholar.google.be/

2010	9	74	8
2011	5	65	6
2012	4	95	7
2013	2	92	8
2014	0	74	4
Total	**45**	**563**	**50**

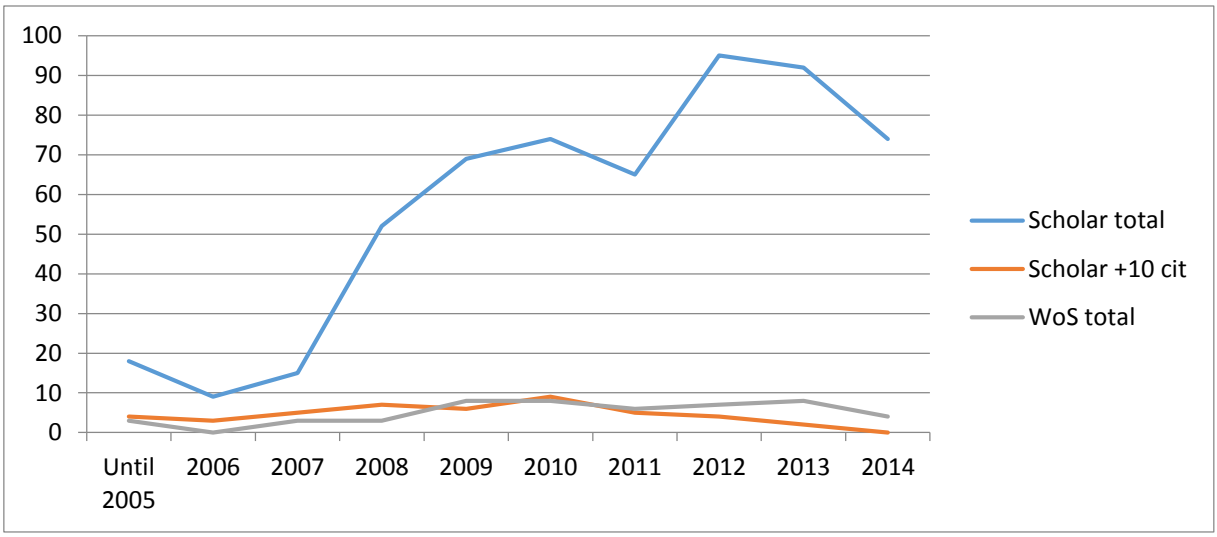

Figure 1: Living Labs papers evolution

In terms of the total articles, we see a clear 'explosion' of research after the establishment of ENoLL, somewhat similar to the growth of ENoLL itself in the first years. The years 2009-2011 seemed to mark a stagnation in the number of published papers, whereas 2010 was the top year of new Living Labs entering the network. However, as the number of new Living Labs started to drop significantly from 2011 onwards, the number of papers started to increase again in 2012 and seems to have stabilized again. What looks more problematic, is the evolution of papers that effectively generate impact. In terms of papers with a citation count of more than 10, no year has yielded more than 10 papers, with a maximum of 9 papers in 2010 being cited more than 10 times.

In terms of Web of Science-papers, we also get the image of a research field 'in development'. When we select all articles in the Web of Science database that have "living lab" in the title and exclude Only 50 papers in total have been published in journals (21) or conferences (29) that are abstracted in this influential database from the almost 600 papers with Living Lab in the title that have been published. Moreover, when we look at the citation count of these papers,

only 2 have more than 10 citations in other WoS-publications: Wolfert et al. (2010) with 24 citations and De Moor et al. (2010) with 11 citations. The majority of the WoS publications (33) even has no citations at all. Moreover, the overlap with our Google Scholar most cited sample is rather scant, with only 8 papers appearing in both list (cf. also the attachments): Budweg et al. (2011), De Moor et al. (2010), Hlauschek et al. (2009), Liedtke et al. (2012), Schuurman et al. (2011), Svensson et al. (2010), Wadhwa (2012), and Wolfert et al. (2010). Therefore, we decided to continue our analysis with the top-cited Google Scholar articles.

For the 45 Google Scholar papers with a citation count higher than 10 the total citation count is 1943, which means an average of 43 citations per paper. Only 5 papers are cited more than 100 times: Abowd et al., 2002 – 135 cit.; Eriksson et al., 2005 – 176 cit.; Niitamo et al., 2006 – 142 cit.; Almirall & Wareham, 2008 – 124 cit. and Følstad, 2008 – 182 cit. Note that none of these papers is also on the WoS.

For Open Innovation, West & Bogers (2013) conducted a similar literature overview which resulted in 287 papers in SSCI journals (Web of Science papers), with the first 10 papers being cited at least 500 times, with Chesbrough's book (2003) even cited more than 8000 times, and Chesbrough being (co-) author of most of the top-cited papers. The same is true when looking for literature with the terms 'User Innovation' and 'lead user', with von Hippel as a dominant figure and easily more than 10 articles with over 400 citations, although the Open Innovation literature is clearly dominant in terms of quantity.

Based on these general statistics, we can conclude that the Living Labs movement in terms of theory and research has taken off since 2006, at least in quantity of published papers. However, **in terms of quality and impact, the academic field of Living Labs is still rather insignificant**. Regarding the authors, 39 papers were authored by European scholars, five by American scholars and one paper originated from Australia (Third et al., 2011). This is further proof that the Living Labs field is clearly dominated by Europeans. However, there is not a single author very 'dominant' as in the Open and User Innovation literature, with five authors (Almirall, Wareham, Ståhlbröst, Eriksson and Feurstein) (co-) authoring 3 papers. This is also a further indication of the scatteredness of the Living Labs field. We will continue the rest of our analysis with the 45 Google Scholar 10+ cited papers. We chose to use this sample as it has some clear advantages. The selection criteria are clear and unambiguous, which enables later reproduction (e.g. for future comparative studies). Moreover, the sample size allows to have a more in-depth knowledge of all the papers, while at the same time representing a fair share of the total amount of papers (8%). However, we also acknowledge some limitations that come with our selection methodology. Papers that do not have "living lab" in the title are excluded (e.g. Ballon et al., 2007), although based on our knowledge of the literature, this has only a minor impact. Perhaps more impact is generated by including the criterion of 10+ citations. This tends to limit the inclusion of the most recent Living Labs papers, as it takes

some time to get cited by even newer publications. However, this would raise the issue on how to measure or assess the quality of these more recent publications. Therefore, we chose to keep our initial criteria and propose future research should adhere to these criteria to include more recent literature that by that time has reached a significant degree of impact.

3 Results & discussion

When going through all the papers, two important issues arise. First, only a small minority of the papers reports on well-grounded empirical research on Living Labs. The majority of the papers are descriptive single or multiple case studies, or conceptual papers relying on desk research, without a rigid methodology being used or explained.

In our sample, 18 out of 45 papers are merely project descriptions with only limited conceptual value (Abowd et al., 2002; Baida et al., 2007; Schwittay, 2008, Hlauschek et al., 2009; Krieg-Brückner et al., 2010; Hess & Ogonowski, 2010; Budweg et al., 2011, Schuurman et al., 2011; Liedtke, 2012; Wadhwa, 2012; Schwartz et al., 2013; Ogonowski et al., 2013) or they describe a single case study where a 'Living Lab approach' is used, but without Living Labs themselves being the subject of the research (Haymaker & Chachere, 2006; Scott et al., 2009; Wolfert et al., 2010; Bliek et al., 2010, Ryu, 2010; Third et al., 2011). Remarkably, all American papers and the single Australian paper are to be found in this category, which is another indication that Living Labs are largely a European phenomenon. Also, the Ryu (2010) paper is the only downright negative paper in the whole sample, as it describes the power relations a large company can exert in the process of ICT introduction in developing countries. All other 44 papers approach Living Labs in a neutral or overtly positive way, which is an indication of the absence of a critical attitude towards Living Labs as a concept. In the Open and User Innovation literature we also encountered mostly positive case studies, but in both fields some critical papers have also emerged. To this day, no real 'critical' Living Labs paper has been published, which is a further proof of the rather low impact of the field in other literature streams.

Table 2: Living Labs paper type

Paper type	Number of papers
Descriptive papers	18
State-of-the-Art papers	4
Conceptual & methodological papers	16
Empirical paper	7

Subsequently, we can discern a category of four papers that contain multiple Living Lab cases, but merely as high-level descriptions and illustrations. First, we have the oldest paper from our sample by Markopoulos and Rauterberg (2000) who give an overview of the American Living Labs that were blossoming at that time, with also examples from this kind of Living Labs in Europe[3]. Next, we have the widely cited papers by Eriksson et al. (2005) and Niitamo et al. (2006) who give an overview of the developing European Living Labs field, also including some of the American examples. As a fourth paper in this category, we have Schaffers et al. (2007) who discern the Living Labs for rural development, which coincides with the fourth type of Living Lab we detected in the previous chapter: Living Labs for multi-stakeholder knowledge sharing and collaboration.

Besides these four 'state-of-the-art' papers, we have a rather large sample (16 or just over 1/3 of all papers) that deal with methodological and conceptual contributions to Living Labs, based on single case studies or purely conceptual papers. Pierson and Lievens (2005), Kusiak (2007), Følstad (2008b), Levén and Holmström (2008), Feurstein et al. (2008), Schuurman and De Marez (2009), Bergvall-Kareborn et al. (2009a&b), Santoro and Conte (2009), Pallot et al. (2010) deal with user contribution and project methodologies for Living Labs. Some papers base themselves on more research data, such as Schumacher and Feurstein (2007) who report on a Living Labs survey, albeit in a very descriptive way. Mulder et al. (2007 & 2008, basically two times the same paper) report on a brainstorming exercise of Living Lab practitioners and maps different methods and tools on a 'harmonization cube', while Svensson et al. (2010) base themselves on user contribution in more than 100 user interaction intstances in three Living Lab projects to inventarize different methods. Ponce de Leon et al. (2006) and De Moor et al. (2010) deal with testbeds in the context of Living Labs, and how to intergrate these, with De Moor et al. (2010) dealing specifically with Quality of Experience as methodology which can support Living Labs and vice versa.

However, only seven papers dig deeper into the Living Labs phenomenon with a larger sample, a more rigid methodological approach or a more in-depth analysis of the cases studied. First, there are two papers containing literature reviews: the Følstad (2008a) paper which we discussed in detail in the previous chapter, and Dutilleul et al. (2010). Although their methodology for selecting the papers is not very clear, the latter paper reaches some interesting conclusions, as Dutilleul et al. (2010) discern five different meanings given to Living Labs in the papers they studied:

1. an innovation system consisting of organised and structured multi-disciplinary networks fostering interaction and collaboration
2. real-life or 'in vivo' monitoring of a social setting generally involving experimentation of a technology

[3] Note that the authors were also European and connected to a Dutch Living Lab.

3. an approach for involving users in the product development process
4. organisations facilitating the network, maintaining and developing its technological infrastructure and offering relevant services
5. the European movement itself

3.1 Levels of analysis

The final paragraph of the previous section raises the issue that not all Living Labs papers are using the Living Lab-concept to identify the same phenomena. The first interpretation from Dutilleul et al. (2010) looks at Living Labs from a systemic or network perspective, which is also the case for the fourth and fifth interpretation. The second is more related to a project structure where several elements constitute the Living Lab character of the project. Living Labs as an 'approach for user involvement' considers more the methodological level within a project: which methods or tools should be used to involve users during innovation development. We also witnessed these different levels in the clusters of papers, as the four state-of-the-art papers clearly considered the Living Lab 'constellations', whereas the 18 papers seem to report Living Labs on a project level. The 16 empirical and methodological papers mix these levels, as some tend to focus on the methodological level, whereas others look on a project or constellation level to abstract lessons and findings.

Moreover, we see these levels of analysis also present in the five papers that we regard as the strongest of the sample in terms of methodology and depth of their analysis. Westerlund and Leminen (2011) and Leminen et al. (2012) make this distinction implicitly, as in the first paper they take the intermediary project level as they discern different ways to manage different levels of user contribution, whereas in the second paper, they report on the constellation level by discerning different actors with specific roles in a Living Lab (cf. infra). Almiral and Wareham (2008, 2011) make the distinction explicitly, as they state that parallel to a macro vision of Living Labs, they focus in a micro vision on the interaction between actors within innovation projects. In Almirall et al. (2012) they only focus on the methodological level, no longer taking into account the macro level.

Therefore, with the above in mind, we propose to make an explicit distinction between these levels of analysis. Different than Almirall and Wareham (2008, 2011) who distinguish a macro and micro perspective, we propose to distinguish three levels of analysis:

On a macro level, a Living Lab is a public-private-people partnership consisting of different stakeholders, organized to carry out Living Lab research and Living Lab projects. We propose the term *Living Lab constellation* to refer to this level. **On the meso level, we discern the Living Lab innovation projects** that are being carried out within the Living Lab constellation. We can also refer to this as a *Living Lab project*. The **research activities** that are deployed in a Living Lab project we propose to label as the **micro level activities** in Living Labs. Mostly, this consists of a specific Living Lab methodology in order

to ‘cultivate user-led insights’ and ‘surface tacit, experiential and domain-based knowledge such that it can be further codified and communicated’ (Almirall & Wareham, 2011). The following table clarifies the different levels of analysis.

Table 3: Levels of analysis

Level	*Description*
Macro level	Living Lab constellation consisting of actors (PPP-partnership) and/or infrastructure
Meso level	Living Lab innovation project
Micro level	Living Lab methodological research steps

Ståhlbröst (2012) noticed that some Living Labs exist where the Living Lab constellation is set-up for only one innovation project, which merges the macro and meso level, but we regard these ‘Living Lab as a project’ initiatives as problematic in terms of sustainability and sub-optimal in terms of added value being generated for the actors involved. We looked into these levels of analysis for our sample of Living Lab papers. To this end, we analyzed the nature of the findings and implications of the paper for Living Labs, and at the type of case that were studied (if there were any). Based on this information, we coded the level of analysis based on the definition we gave to the three levels. Note that some papers deal with multiple levels of analysis (e.g. Almirall & Wareham 2008 & 2011, cf. supra).

Table 4: Levels of analysis in papers

Level	**N**
Macro	29
Meso	15
Micro	20

In terms of the levels of analysis, the focus is clearly on the macro level, with 29 papers looking at the Living Lab constellation. In total 20 papers deal with the micro level, referring to specific methodological aspects of Living Labs. A minority of the papers (15, only one third of the sample) deals with the meso level or concrete Living Lab innovation projects. Moreover, the majority of these papers is merely descriptive as they concern giving an overview of a project

without much analysis regarding the outcomes or regarding implications for Living Labs (e.g. Bliek et al., 2010; Wadhwa, 2012). The majority of the papers only takes into account one level (29), while 16 papers combine multiple levels of analysis. Remarkably, the first papers with multiple levels of analysis appear in 2008, the year Almirall and Wareham (2008) explicitly distinguished between a macro and a micro level view in their analysis. Moreover, before 2008, none of the papers took into account the meso level, dedicating attention to the Living Lab constellation and/or infrastructure, or to the methodology.

3.2 Theoretical frameworks

We also assessed which theoretical frameworks were used in the paper. Therefore we examined the theoretical and introductory parts of the paper and looked which frameworks or paradigms were mentioned as foundations for Living Labs. We looked for indications of the Open Innovation and User Innovation frameworks. We also looked for User-Centered Design and Participatory Design as frameworks, as these evolved from participatory design, one of the predecessors of Living Labs (Schuurman, 2015). In practice, we looked at the occurrence of the 'Open Innovation', 'User Innovation', 'user-centered design' (UCD) and 'participatory design' (PD) expressions, but also for citations of prominent authors associated to the fields such as Chesbrough or von Hippel.

Relating to the different levels of analysis, we would expect that papers taking a macro perspective would rather use Open Innovation as a theoretical framework, as at this level Living Labs are considered organizations or networks consisting of different actors. For the micro perspective, we would expect User Innovation or UCD/PD as main framework as on a methodological level, Living Labs are an approach to involve users in innovation processes. On the meso level, all frameworks seem to be relevant as a Living Lab innovation project consists of different actors collaborating for innovation, including end-users. At this level, we see the Living Lab constellation being put to use, with the innovation projects advancing along the different steps of the Living Lab methodology. As we discovered that the macro level was clearly dominant, we would expect Open Innovation to be the most widely used theoretical paradigm in our sample. The table below gives the numbers of articles where the proposed frameworks are used, together with the number of articles where none of the theoretical foundations were used.

Table 5: Dominant framework

Paradigm	N
Open Innovation	11
User Innovation	17

UCD / Participatory design	19
None	18

Surprisingly, Open Innovation is only explicitly referred to in 11 papers, despite the dominance of articles taking a macro perspective. This can be explained by the fact that in a lot of these papers, terms like open collaboration, Public-Private-People partnership, or even Open Innovation are used without any referral to literature from the Open Innovation domain. **A lot of the Living Labs papers seem to take the use of Open Innovation for granted, without reflecting in terms of the Open Innovation literature base or without apparent knowledge of this literature stream**. Papers like Schuurman and De Marez (2009), Svensson et al. (2010) and Pallot et al. (2010) equal Open Innovation with user involvement and open collaborative innovation, something which was also discussed in West & Bogers (2013). **In 18 articles, none of these frameworks was referred to**, whereas 17 papers referred to the User Innovation literature. The UCD/PD framework is the most cited with 19 papers, which is an indication that **the 'cooperative design' predecessor still has a large influence on the current Living Labs movement**. Moreover, the large amount of papers without reference to these frameworks is remarkable, but also congruent with the previous finding that 18 papers within our sample are for the largest part descriptive without much attempt at theory building. Among the earlier papers with a reference to design thinking, we find especially American authors with references to participatory design and requirements-driven innovation (Abowd et al., 2002; Haymaker & Chachere, 2006; Kusiak, 2007). In Europe, the Scandinavian authors have maintained a strong connection between Living Labs and design thinking (Følstad, 2008a&b; Levén & Holmström, 2008; Bergvall-Kåreborn et al., 2009a).

In the remainder of this paper, we will now explore the occurrence of Open and User Innovation and the related key concepts within our sample, and look how these paradigms have been linked to Living Labs. We will dedicate special attention to the empirical papers from the sample that have not been discussed yet.

3.3 Living Labs literature with Open and User Innovation combined

As we have argued in the introduction, we consider Open and User Innovation as two distinct, but complementary frameworks that make sense of distributed innovation processes. Where the Open Innovation paradigm takes the perspective of a private actor and examines the benefits of engaging in distributed innovation, the User Innovation stream looks at distributed innovation processes from the perspective of the user and looks under which circumstances users can contribute to innovation processes with knowledge or own innovations. We looked into the occurrence of Open and User Innovation literature in the framing of the Living Labs papers from our sample (cf. supra), and were able to distinguish 7 papers in total where both

perspectives are used: Schaffers et al. (2007), Almirall and Wareham (2008, 2011), Levén and Holmström (2008), Bergvall-Kareborn et al. (2009a&b), and Dutilleul et al. (2010).

The oldest paper (Schaffers et al., 2007) is one of the identified 'state-of-the-art' papers from the early start of the European Living Labs movement and describes a 'new' type of Living Lab, with more focus on stakeholder collaboration and knowledge sharing. In the previous chapter we also discovered this type in our fourway segmentation. Therefore, the attention from Living Labs as purely 'user-centered' and 'user-driven' shifted towards a more networked approach, hence Schaffers et al. (2007) ground their experiences in the European C@R-project (cf. supra) in the Open and User Innovation paradigms. The issue of the sustainability of Living Labs is raised, and they argue to develop a 'business model' for Open Innovation in 'rural' Living Labs, taking into account the various dimensions of partnership creation and operation across the different Living Labs development stages, which makes the link with Open Innovation apparent. Only when these 'business model issues' are tackled, the Living Lab operations can generate innovation through users or user communities involved in the Living Lab.

Almirall and Wareham (2008, 2011) explicitly regard Living Labs as a means to overcome the 'European Paradox' between exploration and exploitation by surfacing tacit, experiental and domain-based knowledge in so-called innovation arenas in real-life environments, but separated by a project structure. This adheres to our proposition of Living Labs as a tool for distributed innovation driving on co-creation between different actors, including users. Almirall and Wareham (2008) further suggest that these arenas are supportive instruments for entrepreneurial users, which also merges the User Innovation and Open Innovation perspectives. Based on a cross-case analysis, Almirall and Wareham (2011) conclude that Living Labs have two main functions, which can also be linked to both paradigms. First, they should close the pre-commercial gap by generating initial demand for the innovation in development (user involvement for exploitation), and second, they should be able to orchestrate the actions of the involved actors in order to align the inputs for the innovation process (knowledge exchange for exploration). However, as we will see in the next section, the 'exploitation' perspective is mostly absent in the Living Labs literature, although this is an essential part for solving the European Paradox. Moreover, based on the Open and User Innovation literature, we would expect that exploitation might also occur between the actors participating in an innovation network, whereas (certain types of) users are regarded to be able to contribute to the innovation process, which is a form of knowledge exploration.

Levén and Holmström (2008) deal with the process of value creation in Open Innovation systems. They regard user involvement as essential to enhance ICT-innovation. They also use the 'arena' metaphor for Living Labs and consider them a response to the opportunities identified through Open Innovation models, but also as an opportunity to move university

research out in the wild. Therefore they propose the following model to visualize the actors and activities in Living Labs.

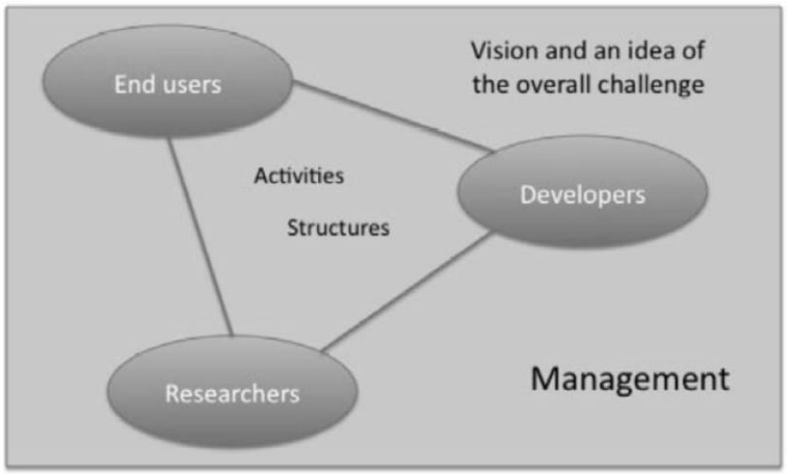

Figure 2: Living Lab actors from Levén and Holmström (2008)

Co-creation is the central value creating process in Living Labs, and university researchers are considered a mediator between end-users and developers, something which is also argued in the work of Almiral and Wareham (2008, 2011). Based on two cases, Levén and Holmström (2008) also dedicate attention to the balance between exploration versus exploitation, and point out to the fact that some sort of innovation system management should be facilitated in Living Labs in order to guard this balance and to foster an optimal exchange of knowledge between the participating actors. They suggest that universities play a crucial role in the well-functioning of the innovation system, but fail to shed light on how this management should be executed in practice and how a balance can be attained. In the next section, we will dig deeper into this matter as we introduce an extension of this Living Labs actor model by Leminen et al. (2012).

Bergvall-Kåreborn et al. (2009a&b) take a radically different approach towards positioning Living Labs among the Open and User Innovation frameworks. They explicitly distinguish Living Labs from Open Innovation, as they state that Living Labs are business to consumer (B2C), focus on the product or service and generate input for the whole innovation process, whereas they consider Open Innovation to be business to business, focusing on the business model and generating input for ideas and technology.

In Bergvall-Kåreborn et al. (2009a) five Living Lab key components are identified: the (ICT) *infrastructure* to facilitate cooperation and co-creation between the stakeholders, the *management* of the interaction and activities, the *partners and users* that participate in the Living Lab, and the *approach* which stands for the methodology, methods and techniques that are used in the Living Lab. They further distinguish five Living Lab principles: influence, openness, realism, value, and sustainability. This is based upon the authors' experience in 30

research projects within two Swedish Living Labs (Botnia and Halmstad Living Lab). However, it is not quite clear how these 'principles' should be used to increase the value or effectiveness of Living Labs or Living Lab projects. The level of analysis is also unclear. Do these principles apply to a Living Lab project (the unit of analysis of their own observations) or to the Living Lab constellation? These issues are left unanswered.

In Bergvall-Kåreborn et al. (2009b) they dig deeper into the 'approach' component or the Living Lab methodology. Again, they propose five key principles to guide the research steps in Living Lab projects: continuity, openness, realism, empowerment of users, and spontaneity. Subsequently, they present their own FormIT methodology for systems design and illustrate this method by means of a case study.

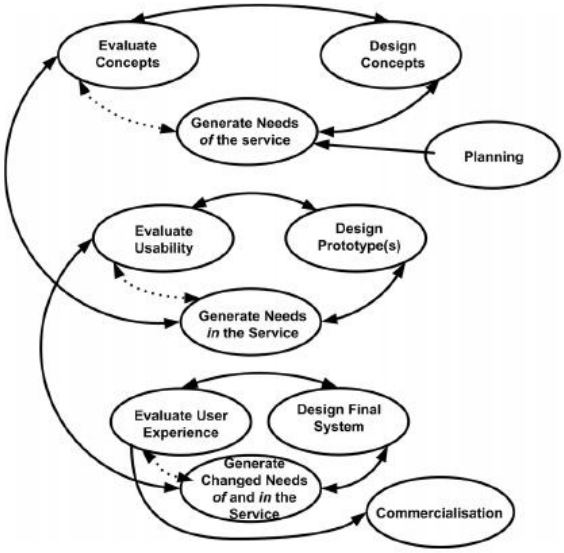

Figure 3: FormIT Methdology by Bergvall-Kåreborn et al. (2009b)

The methodology is rather similar to user-centered design methods, with more emphasis on evaluation and testing of prototypes. However, again it remains unclear how these 'principles' should be taken into account in practice. It also remains very much hypothetical that these methods are 'better' than other innovation approaches, and only successful cases are presented, something which can be put forward as **a criticism towards the majority of Living Labs papers: the lack of critical attitude towards their own methods and *modi operandi***.

However, the final paper building on both the Open and User Innovation paradigms by Dutilleul et al. (2010) raises some critical issues with regards to the Living Labs movement. They base themselves upon a literature review of Living Labs papers, although they never specify how they selected them. As we already noted previously in this chapter, they unveiled five different ways in which Living Labs were used, indicating an inconsistent usage of the concept, not taking into account the different levels of analysis that can be discerned within the

phenomenon. Regarding Open Innovation, they consider Living Labs as multi-business collaborations. They see it as a challenge for Living Labs to maintain their openness towards external partners whilst also generating value for business actors active in the Living Lab. The management role is better awarded to a public actor, as it is easier for them to maintain a neutral stance. Regarding user involvement, they see some issues with regards to user motivation to participate, as they state that most literature implicitly assumes that users are motivated and willing to participate. Dutilleul et al. (2010) see it as a future challenge for Living Labs to achieve and sustain the necessary levels of user cooperation with as motivation better solutions to their problems or better design.

3.4 Living Labs and Open Innovation

Open Innovation processes deal with knowledge exchange between different actors (Chesbrough, 2003). Referring back to the initial goal for the promotion of Living Labs within the wider European innovation system, which was to help solving the European Paradox, or the imbalance between knowledge exploration and exploitation, we would also expect Open Innovation to be more prominent as framework for conceptualizing Living Labs. In order to 'solve' the European Paradox, Living Labs should be able to facilitate the process of exploitation. Therefore, we looked at the Living Lab definitions, and more specifically the goals that were mentioned for the Living Lab activities that were described in the paper. We coded all papers for the three Open Innovation processes of exploration, exploitation and retention, which we defined in chapter 3 (Licthenthaler & Lichtenthaler, 2009; van de Vrande et al., 2009):

Exploration: innovation activities to capture and benefit from external sources of knowledge to enhance current technological developments

Exploitation: innovation activities to leverage existing knowledge or technological capabilities outside the boundaries of the organization

Retention: maintaining, storing and reusing knowledge over time outside of an organization's organizational boundaries

Besides the word exploration itself, we considered words such as experimentation, study (of user behavior), testing,… as indicators of exploration goals. For exploitation, we regarded words and phrases like 'creating initial demand', adoption, technology transfer, implement, and business models to refer to an exploitation goal. For retention, indicators such as knowledge and information sharing, multi-stakeholder communication and rethinking were used. This resulted in the following outcome.

Table 6: Open Innovation processes

Proces	N
Exploration	45
Exploitation	15
Retention	7

All papers (45) define Living Labs and Living Lab activities as an exploration of new knowledge, whereas only one out of three (15) mentions exploitation as a motive for Living Labs, which is surprising as in the previous section it was argued that exploration and exploitation should be balanced. This is also a clear mismatch with the original intentions described in the Helsinki Manifesto (2006) of Living Labs as facilitators of knowledge exploitation. The exploitation motive of Living Labs is the most common in the more thematic Living Labs (e.g. Baida et al., 2007; Hlauschek et al., 2009; Wadhwa, 2012) or Living Lab projects where an innovative infrastructure is rolled out amongst a population (e.g. Schwittay, 2008; Ryu, 2010; Third et al., 2011; Bliek et al., 2010; Schwartz et al., 2013). The fact that knowledge retention is the least common is not a real surprise, as this process was also the least studied within the Open Innovation literature. The seven instances where retention was an explicit goal, were in thematic Living Lab constellations where stakeholders from a certain sector intend to collaborate and exchange knowledge regarding future opportunities (Baida et al., 2007; Wolfert et al., 2010), two projects aimed at sustainable innovation with the creation of user awareness (Scott et al., 2009; Liedtke et al., 2009), the literature review of Dutilleul et al. (2010) who refer to the regional knowledge sharing opportunities of Living Labs, and the two papers by Mulder et al. (2007 & 2008) that incorporate the outcomes of a brainstorming session of Living Lab practitioners in an attempt to create shared tool and methodology set for Living Labs. This is an indication of the imbalance in the attention for the Open Innovation processes in the current Living Labs literature, something which calls for more in-depth research. We will tackle this issue in the next chapter. Moreover, the fact that only 11 papers explicitly refer to Open Innovation as a defining paradigm, but that in all papers references to knowledge transfers between actors can be found, suggests that Living Labs are emanations of Open Innovation. This calls for a better conceptualizing of Living Labs that allows to frame them in terms of Open Innovation.

We continue our overview of Open Innovation in the Living Labs literature by looking more closely to the papers that explicitly position Living Labs within the Open Innovation literature. Almiral and Wareham (2008) argue that Living Labs have a transversal role in Systems of Innovation affecting all groups of activities, as they function as innovation intermediaries (cf. also chapter 3). What makes them novel compared to other intermediaries, is the actor they

mediate: the users. This mediation consists of three new activities: 1) Living Labs provide services around user experience and involvement to companies in the context of projects, aiming to obtain products that relate better to users' needs, concept validation or to capture new ideas that could improve a product or a service, 2) Living Labs support lead users as entrepreneurs providing networking, technical expertise, project management and sometimes funding, 3) Living Labs organize the user involvement in the innovation process by maintaining groups, setting up projects and creating societal involvement. This is in line with the work of Kusiak (2007) who states that within a Living Lab all stakeholders of a product or a service are invited to participate in the development process. The Living Lab thus acts as an innovation intermediary by aggregating all external inputs and translating them into requirements for innovation. This extends the view of Almirall and Wareham (2008) on Living Labs as innovation intermediaries, as they not only mediate the user, but also other stakeholders participating in the Living Lab. As some kind of aggregator of various external inputs, translating them into requirements, the 'Living Innovation Laboratory' supports innovation of products and services that are validated in collaborative, multi-contextual, empirical real-world environments (Kusiak, 2007). Regarding involvement of multiple actors of the innovation ecosystem, Almirall and Wareham (2008) see Living Labs as especially relevant in situations with multiple stakeholders, conflicting interests, and a large 'space of solutions'. In these cases, the innovation problem may only be adequately addressed by involving all actors and stakeholders through their active participation. This way, Living labs provide the solution by tapping into tacit knowledge to be incorporated into products and services, and validated in real-life environments.

This all seems to make perfect sense and gives some indications to when a Living Lab-approach seems to be fitting, although a lot of issues are left untouched. What actor should govern the Living Lab? How is the stakeholder participation facilitated? How to exactly structure and outline the innovation process? These answers are largely left unanswered, and based on his later work (Almirall et al., 2012), it appears that different Living Labs use quite different methodologies in terms of user involvement, without even dealing with the issue of other stakeholder involvement.

Regarding the actors that participate in a Living Lab, we already discussed the integration model of Levén and Holmström (2008) that includes researchers, end-users and developers. The researcher is focused on the production of new knowledge. He/she contributes to the Living Lab with knowledge or studies of technologies or methodologies that are relevant to the Open Innovation process. In exchange for his/her contribution, the researcher will gain from the Living Lab-approach in terms of cases and information available through the cooperation with the other actors. The developer is a stakeholder that aims to develop products or services able to fulfill the end-user needs. Therefore, he/she searches for information and knowledge about those needs and opportunities that are important to the end-user. Nevertheless, its

primary focus is his/her own market and business opportunities. He contributes to the Living Lab with new products, services and solutions as well as with important and competent management in the innovation process as a whole. The end-user is a stakeholder looking for better ways to satisfy his/her needs and better ways to handle his/her current situation. The end-user can contribute to the Living Lab by expressing his/her needs, usage experience and as end-user of the services or products resulting from the innovation system. As suggested by Dutilleul et al. (2010, cf. supra), the management role should be played by a public stakeholder with a 'neutral' attitude in terms of business. Therefore, we can increase the number of stakeholders by adding 'authorities' or 'public organizations'.

However, the most complete account of stakeholder roles in Living Labs, building further on these previous works and based on an analysis of 26 Living Labs from Finland, South-Africa, Spain and Sweden, comes from Leminen et al. (2012). They obtained data form these Living Labs by conducting 103 semi-structured interviews with informants from 39 different organisations participating in these Living Labs. The interviewees included senior managers, project managers, researchers, project coordinators and users. This same data set is used for another paper by this author team that we will discuss in the next section. Based on this empirical investigation and on previous Living Labs literature, Leminen et al. (2012) propose four different Living Lab stakeholders based on their role: utilizers, enablers, providers and users.

- ***Utilizers*** aim to develop their businesses within the Living lab ecosystem, mostly through short-term Living Lab cases. Their focus is on developing and testing their new products and services. These utilizers use Living Labs as a strategic tool to collect data on test-users of their products or services and collaborate with all stakeholders in the Living Lab ecosystem, including the end-users. These actors drive short-term Living Lab projects and can be regarded as short-term, ad hoc 'consumers or partners of the Living Lab'.

- ***Enablers*** can be various public sector actors, non-governmental organizations, or financiers, such as towns, municipalities, or development organizations. This actor provides (financial) resources or policy support in order to start-up and maintain the Living Lab operations.

- ***Providers*** provide the other actors in the Living Lab with their product or service portfolio. They take care of the (material) infrastructure used for the Living Lab operations. Providers are mainly private companies that enter into Living Labs to co-develop new products, services, and solutions to their own business or industry needs, and focus more on long-term results. They attain these goals through their involvement in general Living Lab operations and (possibly) in the Living Lab cases, driven by utilizers.

- ***Users*** are the 'end-users' that are being involved in the Living Lab-operations and in the (short-term) Living Lab cases. In some Living Labs, existing user groups or user communities are involved, while in others the Living Lab operations themselves facilitate the formation of a Living Lab user community.

This stakeholder-model for Living Labs once more stresses the close connection of the Living Lab-concept with the Open Innovation paradigm, as it demonstrates the (supposed) symbiotic nature of the stakeholder roles. This is also reflected in the works of Almirall and Wareham (2008) who identify Living Labs as the first attempt to organize and structure user participation in real-life environments according to the Open Innovation paradigm.

In the typology of Leminen et al. (2012) academic researchers are considered providers because they provide the necessary expertise on user research. Other research such as Levén and Holmström (2008), but also the Triple and Quadruple Helix literature, stresses the importance of universities as a distinct actor in the innovation ecosystem (Perkmann & Walsh, 2007; Etzkowitz, 2008; Arnkil et al., 2010; Cosgrave et al., 2013). Moreover, the contribution of academia is not limited to user research, as it can also include research on technical topics related to the focus of the Living Lab, or policy and business research. Therefore, we distinguish **researchers** as a separate type of actor within the Living Lab constellation. Based on the various roles of the Living Lab actors and the central role of the infrastructure, we propose the following theoretical illustration of a Living Lab constellation.

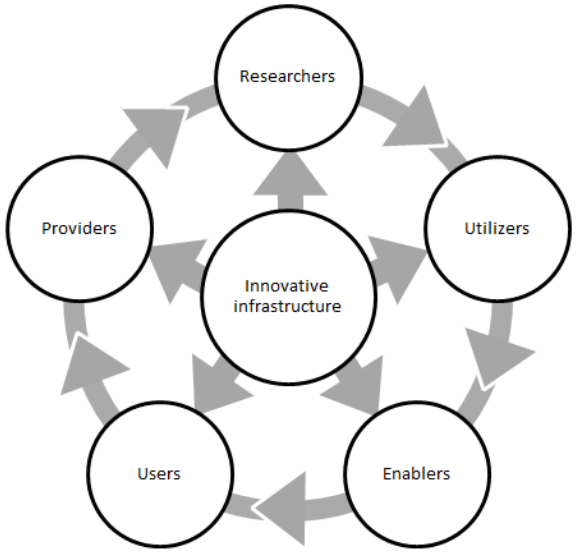

Figure 4: The anatomy of a Living Lab constellation

However, the work of Leminen et al. (2012) merely describes the different roles they discerned based on the analyses of the interviews and other data they gathered from the Living Labs they studied. Once more, this is an indication of the dominance of Living Lab practice over Living Lab theory, as this model was constructed based on the actual practice within these Living Labs.

3.5 Living Labs and User Innovation

We now turn over towards the appearance of User Innovation within our sample of Living Labs papers. As within the Living Lab definitions user involvement and user co-creation are essential characteristics, we looked in our sample for the degree of this user involvement. From the chapter on User Innovation and from some of the papers within our sample, we gathered that user contribution can differ in terms of the degree of involvement. As key framework, we chose the categorization of Kaulio (1998), who discerns innovation/design for, with and by users. *Design for* denotes an innovation approach where user involvement is limited to passive user feedback, gathered through Voice of the Customer-methods or user behavior studies, as were conducted in the American Living Labs. *Design with* denotes an innovation approach based on co-creation, as users and manufacturers work together in an iterative manner, where the locus of innovation can be seen as shared between both involved actors. *Design by* refers to an innovation approach where users innovate themselves, which is in line with the Lead User-approach and the CAP, as the locus of innovation resides with the user.

Table 7: User involvement mode

Design…	N
For users	11
With users	34
By users	0

We looked at all articles and assessed what the dominant mode of user involvement was for the Living Lab activities that were described in the paper, or in the case of conceptual papers how the user contribution was defined. Not surprisingly, design with users, or the co-creation stance, was dominant in the majority of the papers (34). None of the papers described activities where the 'innovation by users'-mode was dominant, although it was described in some papers (cf. infra). However, it is remarkable that the majority of the papers refers to co-creation with end-users, but only 17 papers mention User Innovation as anchoring paradigm. Apparently, the current Living Labs do not support true User Innovation, or at least do not see this as the dominant form of user contribution. Design for users, where the user only plays a passive role in the innovation process, is the dominant mode in 11 papers, including the American Living Labs and the real-life testbeds with passive user observation or simple evaluation, and some papers that deal with Living Lab projects where technologies are rolled out amongst a group of users with technical testing in real-life as main goal.

Regarding the rest of the papers that dealt with the User Innovation paradigm explicitly, we would expect that the roles and characteristics of end-users in Living Labs would be described and researched in greater detail because of the user-centric nature of Living Labs. However, when going through the literature, this was not really the case. Lead User methods are mentioned in the context of Living Labs when overviews of methods to be used are presented (e.g. Pallot et al., 2010; Kusiak, 2007), but how this should exactly be approached remains unclear. In the works of Almirall et al. (2012), the Lead User concept also pops up with no clear specification on how to implement this, except for 'selection of relevant users' (Almirall et al., 2012). The Lead User method is also displayed as separate from Living Labs, with a slight overlap. The same goes for Pallot et al. (2011), who consider the Lead User-method as one of the user involvement techniques that are being used in Living Labs. Interestingly, Almirall and Wareham (2008) consider Lead User entrepreneurs as an important stakeholder group in Living Labs, something which is also mentioned by Pallot et al. (2011). **This means that Lead Users are sought to be involved in Living Lab projects to contribute to the innovation process, but that Living Labs are also enablers of User Innovation by Lead Users as they provide services that allow entrepreneurial Lead Users to develop their innovation.**

In terms of methodology, we already mentioned the FormIT methodology by Bergvall-Kåreborn et al. (2009b), but this methodology was specifically designed for ICT service design and does not take into account any user characteristics. However, none of the above provides a more tangible methodological framework to implement these user involvement methods or user types. In the majority of the literature, Living Labs are considered as 'empty boxes' where different methods and tools can be used, and which should adhere to certain criteria, but more guidance towards designing and managing Living Lab projects is scarce.

The most detailed attempt at drafting a more generally implementable Living Lab methodology, starting from a user innovation point of view, can be found in the work of Pierson and Lievens (2005) who also suggest taking into account user characteristics. They describe different elements constituting the set-up of a Living Lab-project, based on a multiple case study research. Their analysis unveils the following five elements which consist of the following steps:

Table 8: Living Lab methodology according to Pierson & Lievens (2005)

Contextualization	an exploration of the technological and social implications of the technology or service under investigation; technological scan and state-of-the-art study

Selection	identifying potential users or user groups; this can be done on a socio-demographic level, based on selective or criterion sampling, allowance for theoretical variation of previously defined concepts
Concretization	an initial measurement of the selected users on current characteristics, behavior and perceptions regarding the research focus, in order to enable a post-measurement
Implementation	the operationally running test phase of the Living Lab; research methods: direct analysis of usage by means of remote data collection techniques (e.g. logging), indirect analysis based on e.g. focus groups, interviews, self-reporting techniques…
Feedback	an ex-post-measurement of the users (same techniques of initial measurement) and a set of technological recommendations from the analysis of data gathered during the implementation-phase

Note that this general Living Lab-methodology shows quite some overlap with the Lead User-methods we discussed earlier. Characteristics, behavior and perceptions regarding the domain-focus of the innovation are explicitly mentioned as important criteria, as well as the identification of potential users or a potential user group. However, we feel that this already narrows the scope too much, as users that are not likely to become actual adopters or users of the innovation might also provide useful inputs.

The pre- and post-measurements of the users stress the ability of a Living Lab methodology to assess changes in attitudes, habits, practices,… regarding the innovation in development and allows to uncover the 'added value'. Reflecting back to the original American notion of Living Labs, this methodological set-up remains very similar to the traditional quasi-experimental design (Campbell & Stanley, 1966). The first three stages can be considered as the 'pre' stage, the implementation phase as the 'intervention' and the feedback phase as the 'post' stage, with the difference that this is carried out in a non-laboratory or real-life environment.

Table 9: Methodological design Living Lab research

Pre-test	*Intervention*	*Post-test*
- Contextualization - Selection	- Implementation	- Feedback

- Concretization

From the literature on User Innovation, we also gathered that there are some barriers to user involvement and user contribution. It was suggested that contextualization and triangulization could be used to overcome these barriers. Taking into account the described quasi-experimental design and the real-life experimentation, Living Labs might be able to overcome these barriers. However, the literature itself is silent regarding these possibilities or regarding concrete outcomes.

4 Discussion & conclusion

Out of this overview of the theoretical state-of-the-art of the field of Living Labs, we have gathered that the practice-based side is much further developed than the theoretical side. In terms of empirical research and academic publications, Living Labs have received some attention, but this attention is virtually absent in top ranked journals. **There is also a lack of empirical, more quantitative and comparative studies that focus on the added value of Living Labs**. For the few studies that base themselves on empirical research into Living Labs, it remains difficult to make general comparisons or conclusions as most of the studies are not clear regarding their level(s) of analysis. Therefore we have proposed three distinct levels of analysis for Living Labs: the macro level, which concerns the Living Lab constellation, the meso level, which entails the innovation projects that are carried out within these constellations, and the micro level, which consist of the methodological steps that are carried out within these projects.

However, in the Living Labs literature, neither Open nor User Innovation is the dominant paradigm. Referring back to the Living Labs predecessors, it is the User Centered Design that originated from the Participatory Design movement that is still dominant. Strikingly, 18 out of 45 papers refer to no framework at all, remaining merely descriptive. User Innovation occurs more frequently than Open Innovation, but it seems that in recent papers Open Innovation is more and more adopted within the Living Labs literature. This is in line with the trend we also discovered in the previous chapter on Living Labs practice, where we noticed the emergence of a new type of Living Lab constellation, based on multi-stakeholder collaboration and knowledge sharing, rather than on user involvement.

However, in the Living Labs papers that deal with Open Innovation, for the most part this is equaled to open collaborative innovation, as it is argued that Open Innovation stresses user involvement and that Open Innovation takes place in a process of co-creation with internal and external parties. This ignores Open Innovation processes such as licensing and buying, which do not involve any form of co-creation at all. For example, this is also apparent in Westerlund and Leminen (2011) who see Open Innovation as a driver for user involvement and mention

open source and crowdsourcing as alternatives to conventional in-house development. Based on their research, we proposed five distinct stakeholder roles within Living Labs: users, utilizers, providers, enablers and researchers. Despite the fact that Open Innovation is far from the dominant reference framework in Living Labs literature, we could find references to knowledge transfers between actors in all of the papers. As we considered this as one of the key characteristics of Open Innovation, we can conclude that Open Innovation is implicitly present within Living Labs. Referring to the 'European Paradox', or the apparent gap between knowledge exploration and exploitation, at least in the literature there is also an imbalance in Living Labs. All of the Living Labs papers refer to knowledge exploration processes, whereas only one out of three papers mention exploitation processes. At least in terms of the Living Labs theory, there seems to be an issue with overcoming the European Paradox as there is too much focus on exploration.

Regarding User Innovation, 17 papers explicitly refer to this paradigm as theoretical foundation, but in all papers user involvement is a given which also shows that User Innovation is at least implicitly present in the Living Labs literature. Regarding the degree of user involvement, one of the key frameworks we identified in the User Innovation literature, 'design with users' is dominant in the majority of the papers, whereas 'design for users', or the classical 'voice-of-the-customers' techniques, is the main user involvement mode in 11 papers.

However, based on the literature, there is no general methodology towards user involvement in Living Labs, and the literature from the User Innovation paradigm is rarely extensively mentioned or implemented in the context of Living Labs. The Lead User concept pops up from time to time, but no clear method on how to implement this is provided. The only main difference in user involvement approach between Living Labs was so-called open user involvement (self-selection) versus closed user involvement (selecting users with certain characteristics). The most clear definition sees Living Lab projects as a quasi-experimental approach with a 'pre' and a 'post' assessment of users with an intervention stage. This adheres to the three principles of Dell'Era and Landoni (2014), as this allows to capture the use context, the artifact can be seen as the intervention with the innovation or another stimulus (Proxy Technology Assessment, Prototype,…), and the user is actively involved in multiple stages (triangulization). **Our main conclusion is that in terms of methodology and user characteristics, the Living Labs literature is rather silent and positions Living Labs too much as an 'everything is possible' concept that resembles an empty box, in the sense that you can put whatever methodology or research approach inside.** It remains a given that users are involved in Living Labs, but although co-creation was said to be the central process in Living Labs (Levén & Holmström, 2012), 11 papers mentioned 'innovation for users' as the dominant interaction mode. For the 34 papers where 'innovation with users' is dominant, no clear co-creation methodology is put forward. Therefore, within the current Living Labs

literature, it remains unclear whether Living Labs hold value in terms of structuring user involvement according to User Innovation theory.

However, based on the previous, we wish to extend the framework with the levels of analysis towards a more encompassing model of Living Lab activity. In this chapter we gathered that in terms of theoretical frameworks, Open Innovation seems to be fitting to study the interactions and knowledge exchanges within the Living Lab constellation (macro), whereas User Innovation would be able help defining and choosing the most appropriate ways of user involvement on a methodological level (micro). On the meso level, we see both streams merge as the outcome of an innovation project can be influenced and shaped by both the Living Lab constellation as well as the Living Lab methodology.

Table 10: Living Lab three layer model

Level	Definition	Research paradigm
Macro	Living Lab constellation consisting of organized stakeholders (PPP-partnership)	Open Innovation: knowledge transfers between organizations
Meso	Living Lab innovation project	Open & User Innovation: real-life experimentation, active user involvement, multi-method and multi-stakeholder
Micro	Living Lab methodology consisting of different research steps	User Innovation: user involvement & contribution for innovation

This leads us to propose an update of our Living Lab definition from the introduction, taking into account the three levels. We defined Living Labs as an organized approach (as opposed to an ad hoc approach) to innovation consisting of real-life experimentation and active user involvement by means of different methods involving multiple stakeholders, as is implied in the Public-Private-People character of Living Labs. With our three-layered model, we propose the following definition: Living Labs are an approach to innovation consisting of three separate, but interrelated levels of analysis. On the macro level, Living Labs are a Public-Private-People partnership organized to exchange knowledge and conduct innovation projects. We regard these Living Lab innovation projects, that are characterized by active user involvement, co-creation, multi-method and multi-stakeholder, as the meso level. These projects consist of different research steps that are aimed at generating user input and

contribution to the innovation process, which we consider to be the micro level. Open Innovation can be used to study the knowledge tranfers on the constellation level, whereas User Innovation can provide insights into user contribution and user involvement methods.

Therefore, based on our model, we consider the main distinguishing Living Lab characteristics to be situated at the meso level. This does not match with the current focus in the Living Labs literature, as 29 papers or almost two out of three take into account the macro level, whereas 20 papers deal with the micro level. Only a minority of one out of three takes into account this meso level. Moreover, the majority of the papers only takes into account one level (29), while 16 papers combine multiple levels of analysis. This focus on the macro level is also not consistent with only 11 papers mentioning Open Innovation as theoretical foundation.

A final observation is the lack of critical papers on Living Labs (only one out of our sample of 45) and the lack of research clearly assessing the added value of a Living Lab approach on neither of the three levels of analysis. Katzy and Turgut (2010) state that for the innovation performance of individual Living Labs a valid research methodology still needs to be developed. According to them, the measurement of the efficiency of Living Lab processes and structures would serve two purposes: legitimating the (EU) research budget that has been used to stimulate the establishment of Living Labs, but also for potential modification of the concept or certain aspects of it. Therefore, in the next chapter we will analyze a subset of Living Labs on all three levels, taking the Open and User Innovation paradigms as foundations for this analysis, and assessing the outcomes that were generated on the three levels: the outcomes for the actors and the innovation network in which they operate, refered to as the Living Lab constellation (macro), the outcomes for the instigators of innovation projects taking place in these constellations (meso), and the outcomes in tems of user contribution related to the methodology and research steps in these projects (micro).

This leads us to two main conclusions. First, with regards to our observation that the current Living Labs literature is not very developed in terms of academic impact, this provides opportunities to link up with both Open and User Innovation in a more consistent way in order to establish Living Labs as a research field. Second, as Living Labs include both elements of Open and User Innovation, and as the Living Lab characteristics seem to match with certain barriers and problems with both Open and User Innovation, this might extend the role of Living Labs as a structuring framework that fosters knowledge exchanges and user contributions.

This way Living Labs offer an organized approach towards interactive coupled Open Innovation, as proposed by Piller and West (2014). They propose ‘interactive coupled innovation’ between organizations and users as a model illustrating the convergence between Open and User Innovation.

The contribution to the gap between Open and User Innovation is that Living Labs offer an integrated approach by means of their specific characteristics. This enables Open and User Innovation activities and processes to take place, and by using our lens we can measure the outcomes of these activities. Living Labs provide a structured way of facilitating co-creation by connecting the Open Innovation capabilities of stakeholder with the innovative capacities of end-users mediated and facilitated by researchers and specific methodological Living Lab characteristics. Moreover, our three-way model offers a structured way to analyze these different phenomena and to investigate possible relations and dependencies between concepts and phenomena from both paradigms. The levels of analysis also enable to assess the impact of variables or contributions.

We see the meso level as the 'arena' where Open and User Innovation concepts 'clash' and are put to practice in innovation processes from the project instigators, involving end-users and other stakeholders. The macro level provides the overarching constellation and infrastructure which allows to facilitate these projects and gather all relevant stakeholders, whereas the meso levels provides the tools and methods to foster user contribution for these projects. Therefore, the process of co-creation becomes tangible on this meso level and can be subjected to analysis, relating the outcomes to the antecedents from both the macro and micro level, which would lead to a better understanding of co-creation as a process, a process that links the Open and User Innovation perspectives inherently. Open and User Innovation present two different approaches to the same reality. From both, we were able to abstract some relevant concepts and frameworks to describe and denominate Living Labs processes. However, we also discovered that these concepts and frameworks operate largely on different levels within Living Labs phenomena. We proposed a lens to look at Living Labs consisting of three layers: a macro level consisting of the Living Lab organization, being a Public-Private-People partnership, aimed at knowledge exchange and collaboration. All the ENoLL Living Labs are situated at this macro level. Open Innovation provides adequate concepts to study the knowledge transfers between these stakeholders and link these to the organizational characteristics. Moreover, the constellation can be labeled as an innovation network, whereas concepts and frameworks regarding networks and interrelationships can be used to study these constellations. On the meso level, we distinguish Living Lab innovation projects that are characterized by active user involvement and real-life experience aimed at innovation development. These user-related characteristics are facilitated by the micro level, being the methodological steps that are used within a Living Lab project. These user involvement methods and tools can be studied and are provided by User Innovation research. In other words, Living Lab projects are situated at the intersection of Open and User Innovation and provide a general structure and governance to the Open and User Innovation aspects. Therefore, we propose to represent our Living Lab methodological framework as follows:

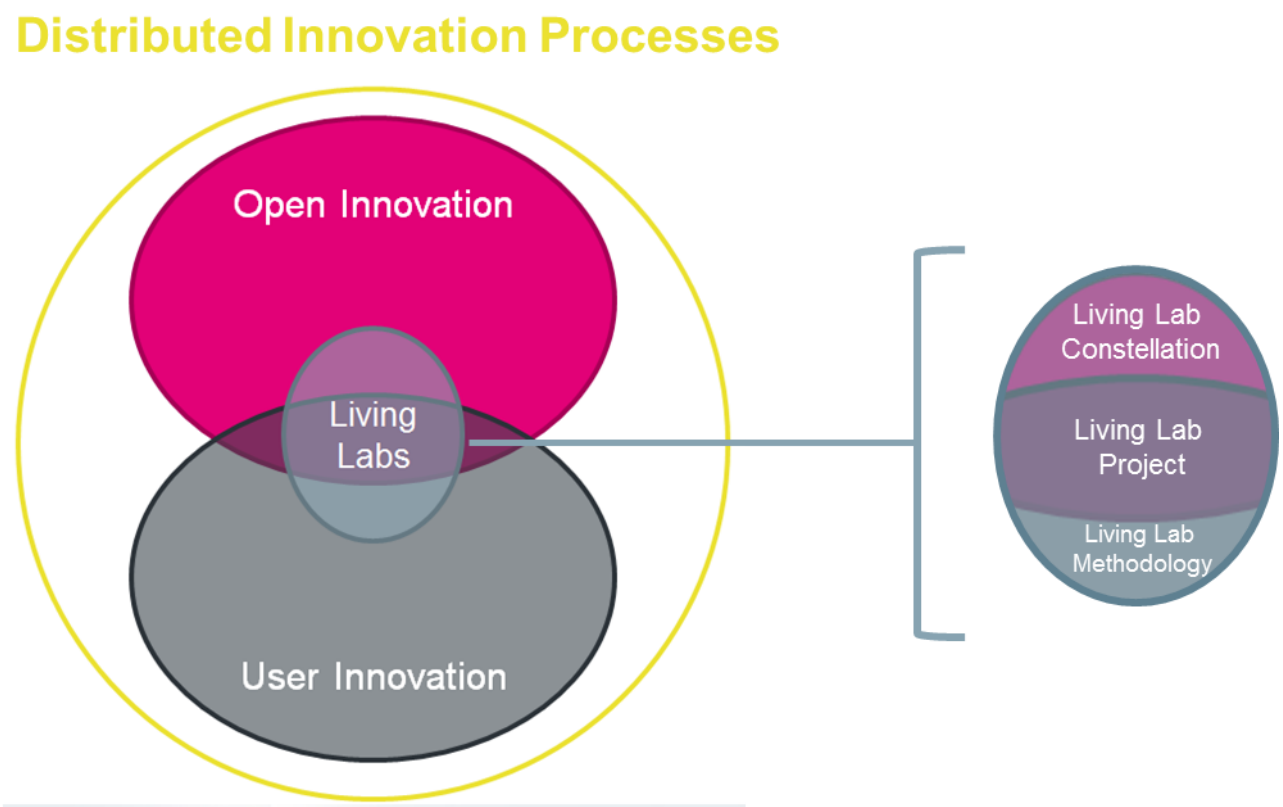

Figure 18 Living Labs theoretical model

Instead of positioning co-creation in Living Labs as potential bridge between these different areas of research within the larger domain of distributed innovation processes, we position our three-layered Living Labs model as a structural approach towards distributed innovation processes with the upper part exclusively in the realm of Open Innovation and the lower part exclusively in the realm of User Innovation. These areas correspond with the macro level (constellation) and the micro level (methodological steps) respectively. The intersection coincides with the meso level (project). Notice that Open and User Innovation also show more intersection space beyond Living Labs, as user-company co-creation and other merging perspectives such as user entrepreneurs are phenomena that are not per se related to Living Labs.

According to the above model, we consider Living Labs as an example of the interactive model of Open Innovation by Piller and West (2014), who take a process perspective, including the stages *defining*, *finding participants*, *collaborating* and *leveraging*. The difference between Living Labs and this model is the presence of an overarching structure, the macro level, which is a PPP organization of stakeholders, that facilitates the Living Lab project. Some of the stages can be carried out or facilitated by designated stakeholders, such as selecting and finding participants. Through the organizational character of the constellations, different stakeholders are able to specialize in certain tasks related to the interactive Open Innovation processes, which also facilitates retention processes and specialization. By having an organization that

carries out multiple projects, knowledge can be accumulated and skills refined. This also lowers the tresholds for organizations to engage in Open Innovation, something which we could confirm in our studied Living Lab projects, as the majority of the instigators could be labeled as a start-up or SME without much experience in Open Innovation.

Moreover, the ‘real life experience’ and ‘multi-method’ characteristics of Living Labs impose extra criteria with regards to the nature of the collaboration. Therefore, given this model on coupled Open Innovation, where Open and User Innovation come together, Living Labs are less a bridge between these two paradigms, but rather provide structure and organization to user participation in Open Innovation activities. Based on our case study analysis, we can conclude that given certain criteria are met, Living Labs have the potential to deliver value to the involved actors by facilitating user contribution that is useful and actionable for innovation development.

References chapter 6

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